Intel® 810E Chipset
Great Performance for All PCs

Revision 1.3

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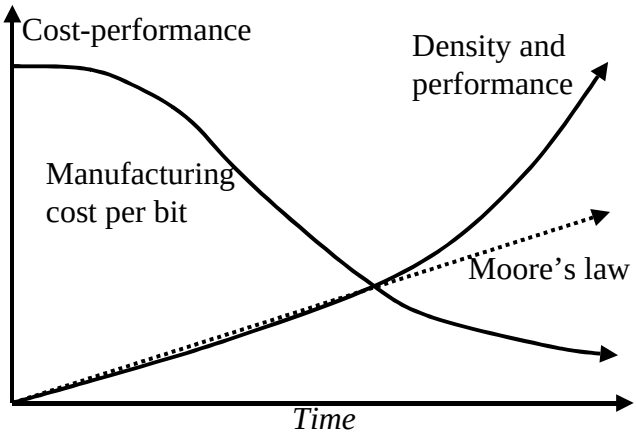
1. Introduction

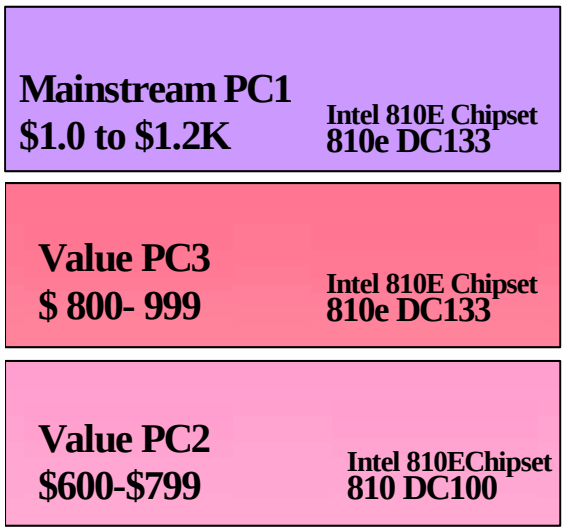
The trend of greater integration as a result of finer line widths commonly referred to as "Moore's law," and improved yield rates in silicon manufacturing has resulted in denser, more sophisticated integrated circuits that are sub-systems within themselves. Combined with this development has been a dramatic reduction in costs resulting in a price-performance curve that actually exceed Moore's predictions. The result has been bigger, faster processors larger, less expensive memory; and dramatic improvements in graphics performance.



These trends have fueled the revolution in overall cost reduction of PCs and have helped usher in the sub $1,000 class machines with the sub $500 class systems already on the launch pad.

Just a few years ago reducing the cost of a PC meant using either older or slower parts. The machines, as a result, quickly became obsolete, their value diminished, and the user base didn't expand very much. With the dramatic improvement in cost-performance of semiconductors realized in the last two years those out-dated notions of cost = performance have been put to rest and today's consumer expects and gets a state-of-the-art machine at an incredibly reasonable price — one approaching, if not at, consumer electronics prices.

The market today is segmented into four primary (high-volume) classes, as illustrated in the following diagram.



- Intel 810E chipset with 66/100/133MHz variable bus, 133MHz local Gfx Display Cache memory, now enters into mainstream segment
  - Flexible, cost effective 3D Gfx mainstream platform
  - SFF, Socket and Slot
    - **Small /Socket support**
- Intel® 810 chipset with 66&100 variable system bus, MHz local Gfx Display Cache memory, Basic Consumer platform
  - Cost effective 3D Gfx value performance
  - GMCH A3 Slot and Socket
    - **Intel® 810 GMCH-A3 support**

Figure 1. PC Market segments

The Intel® 810E chipset offers computer manufacturers the flexibility to reuse one product across several market segments – from Value PC's to Mainstream PC's. These market segments also include sub-categories, which includes the new mini and micro systems being offered in clever and attractive housing. Design reuse benefits the manufacturer by saving R&D dollars, and benefits the customer with a reduced system cost.

The value segment

With the introduction of lower cost processors and chipsets, a new class of products has firmly established the "Value Segment". Aptly named, the Value Segment opens the door to making the PC as ubiquitous in the home as it is in the office.

The Mainstream segment

For computer users who needed more power, flexibility, expansion, or capacity, the leading computer suppliers offer products in what is known as the Mainstream segment. These products are the traditional systems most often found in commercial environments and many SOHO situations.

Graphics Evolution of PCs

Intel introduced the Accelerated Graphics Port to improve the memory access speed for graphics controllers. It is implemented in a specialized core-logic chipset that manages the memory needs of the processor, the graphics controller and various other peripherals, as illustrated in the following diagram.

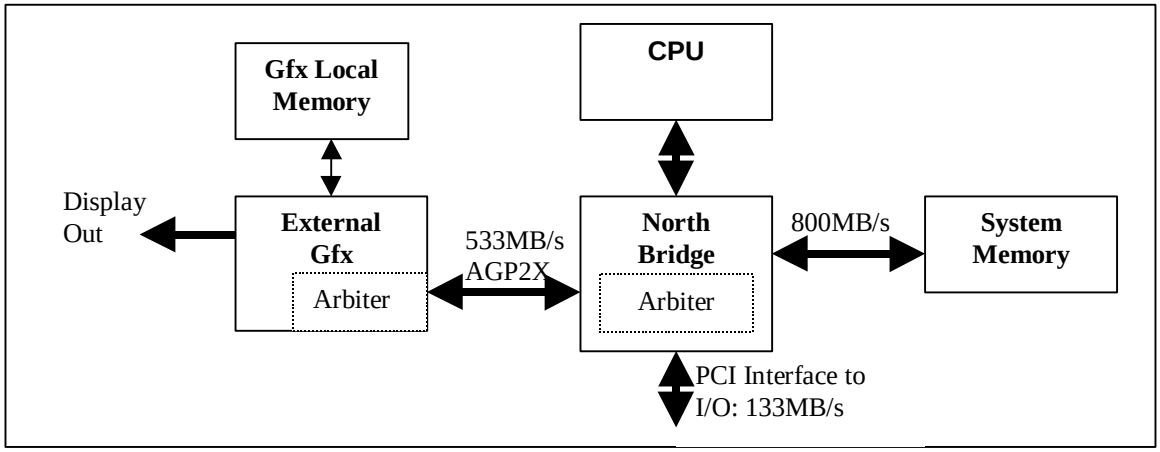


Figure 2. Discrete AGP Architecture

The Arbiter block within the external graphics component schedules requests for data over the AGP. The Arbiter block within the north bridge schedules requests for data for the external graphics, the PCI interface, CPU, and system memory. Graphics performance is enhanced in this architecture because the graphics controller has its own local memory and therefore provides fast access to critical graphics data, free from scheduling delays imposed by each of the arbiters.

There is more that can be done to reduce costs, however. The discrete AGP architecture offered by existing chipsets is not ideal for all segments of the PC market due to the additional system design costs which are passed on to the consumers. These additional costs are added by components such as the discrete graphics chip and local memory. Another cost that gets added is the expense associated with the additional design complexity created by the increased number of connections and board size or component density requirements.

Integrated Graphics

One approach to lowering overall system cost is to simply integrate a graphics (Gfx) core in the same package as an existing north bridge and remove the local graphics memory, as illustrated in the following diagram.

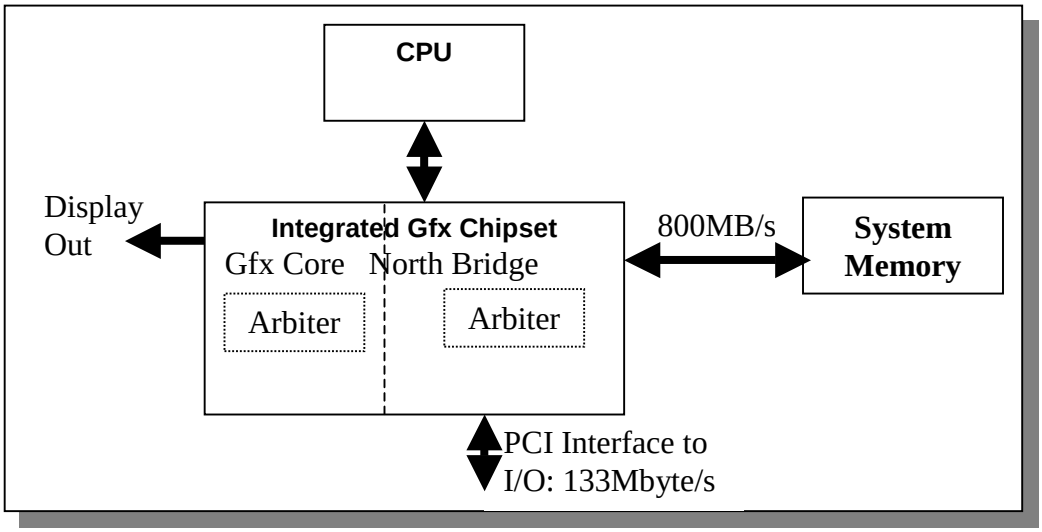


Figure 3. Typical Approach to Graphics Integration

This approach reduces the number of components and design complexity of the system; however, it does so at the expense of performance. In this implementation, the graphics core (Gfx core) accesses the system memory for all graphics data (which shares memory space with applications data). Without re-engineering the interface between the graphics core and North Bridge the graphics core may be subject to both arbiters' scheduling delays. In contrast to the discrete AGP architecture with graphics local memory, the graphics core will no longer be guaranteed fast access to critical graphics data. While this approach provides some cost savings for mid-range graphics, it will not match discrete implementations designed for higher performance/higher priced systems.

Intel introduced its first shared memory (utilizing main memory for display and 3D graphics functions) chipset with the introduction of the Intel® 430VX PCIset in 1996. The 430VX provided an option for the elimination of a frame buffer, assigning a fixed portion of main memory for screen refresh and 3D requirements. This shared memory implementation was characterized by req/grant based static assignment of main memory at boot time. Until today, improvement of this implementation has been limited to the simple integration of graphics cores into the traditional North Bridge chipset.

Integration not only offers more performance at a lower cost; it also shrinks the overall size of the PC. With small form factor (SFF) designs, PC's can fit into spaces smaller than before. Paired with technology like LCD flat panels, Intel® 810E chipset-based systems bring a new meaning to thin PC's – literally.

2. Intel® Graphics Technology for all PC Segments

The Intel 810E chipset extends Intel's graphics capabilities into the Performance and Value PC segments by incorporating 2D and 3D capabilities with the memory controller.

The Intel 810E chipset makes two major improvements over today's shared memory solutions:

- Integration of memory controller and graphics capability (Direct AGP)
- Advanced dynamic memory utilization (Dynamic Video Memory Technology – DVMT)

The Intel 810E chipset also maintains code compatibility with other members of the Intel® graphics family (including the Intel 75x class of stand-alone graphics controllers and earlier versions of the 810 chipset family).

The Intel® 810E Chipset Approach: Smart Integration

The system block diagram in Figure 4 shows Intel's new approach to graphics and chipset integration.

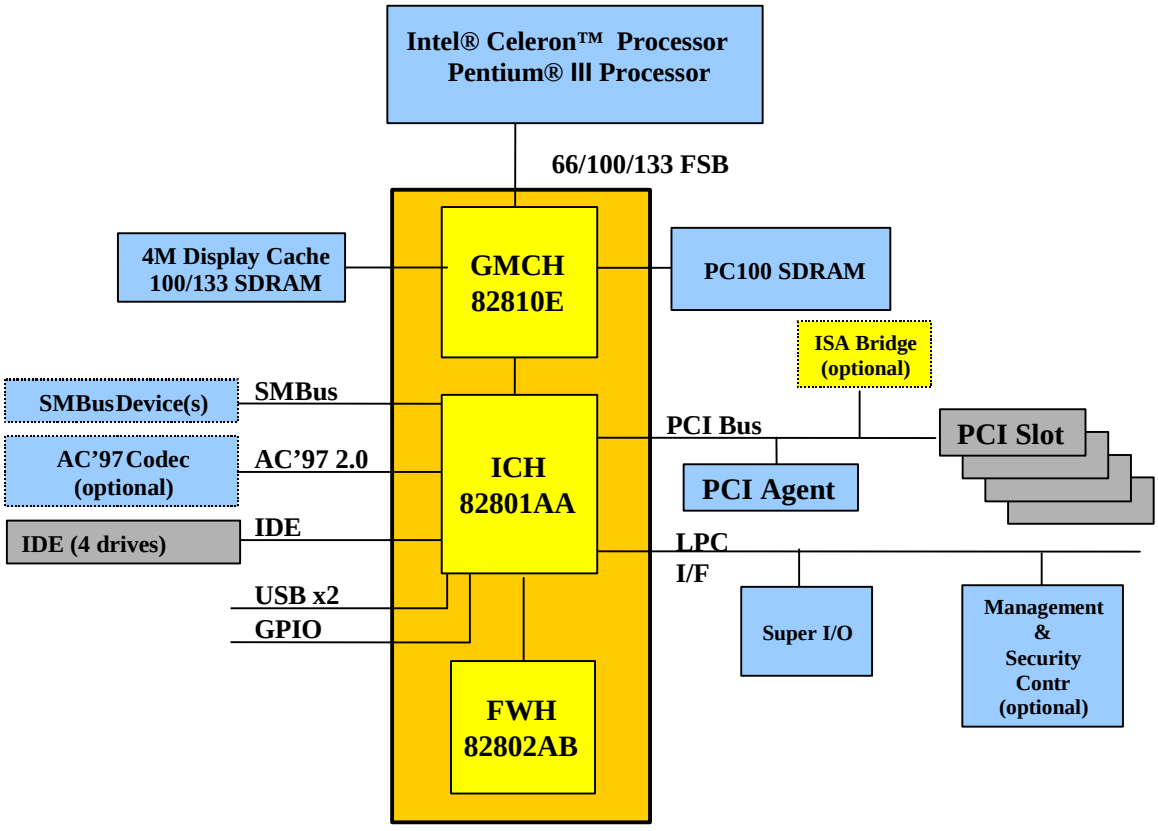


Figure 4. The Intel 810E Chipset Smart Integration

The Intel 810E chipset is the result of new design approach to optimize the shared memory architecture while maintaining the cost benefits of integration through Direct AGP and Dynamic Video Memory Technology.

Direct AGP

Direct AGP delivers AGP class graphics performance to PCs at reduced cost. Rather than simply combining two semiconductor cell libraries for component reduction, Intel architects combined the 2D and 3D video capabilities with the memory control unit. This functional overlap within the Graphics and Memory Controller (Intel® 82810E) enables Direct AGP.

Direct AGP provides an integrated graphics part with the capability to make direct memory set-up calls (similar to those associated with standard AGP protocol) to system memory. Direct AGP calls can dynamically allocate and de-allocate system memory for complex 3D textures, preserving the benefits of standard AGP add-in solutions.

Dynamic Video Memory Technology

Dynamic Video Memory Technology (DVMT) enables breakthrough graphics and memory performance for all PC segments through Direct AGP and highly efficient memory use. DVMT ensures the most efficient use of all available memory – regardless of whether a frame buffer is present or the size of the main memory– for maximum 3D graphics performance. DVMT also responds to application requirements by automatically allocating the proper amount of display and texturing memory. For example, a 3D application might require more texture memory to enhance the richness of 3D objects. The operating system (OS) views the Intel 810 and 810E chipset driver as an application which uses Direct AGP to request re-allocation of additional memory for 3D applications and returns memory when not required.

DVMT is highly scalable — as additional memory is added to the system, more memory will be available to enhance 3D applications. DVMT works dynamically and modulates the bandwidth available to the CPU, graphics and I/O interface, through the intelligent arbitration built into the Intel 82810E. This hard-coded logic evaluates the operating environment and prioritizes traffic to maximize bandwidth for memory intense multimedia applications.

Memory Usage with DVMT

The operating system requires allocation of up to 1Mbyte of system memory to support legacy VGA. System properties will display up to 1Mbyte less than physical system memory available to the operating system.

The graphics driver for the Intel 810E/810 chipsets configurations will request up to 4Mbyte of memory from the OS to implement a maximum 1024 x768 screen resolution, 2Mbyte for a command buffer and 4Mbyte used for z-buffering. For high-end 3D applications, the drivers request allocation of system memory from the OS for graphics textures. When the 3D application is closed, the O/S will re-allocate system memory back for generic use.

For the Intel 810E chipset PC100 configuration, the graphics driver provides the address of an external 4Mbytes of 133MHz SDRAM display cache to store z-buffering. Storing the z buffering in the external 4Mbyte display cache provides increased 3D performance. A maximum of 6 Mbytes of system memory is allocated for the frame buffer and the remaining graphics data structures. The following table shows the optional graphics configuration with different sizes of main memory.

32Mbyte main memory	32Mbyte with display cache	64Mbyte main memory	64Mbyte with display cache
• Lowest cost solution • 2D support for all resolutions • 3D capability best at 640x480 video resolution	• 2D support for all resolutions • 3D capability best at 800x600 video resolution	• Enhanced performance • 2D support for all resolutions • Optimized 3D resolution of 1024x768	• Optimal performance • 2D support for all resolutions • Optimized 3D resolution of 1024x768

Table 1. Typical main memory configurations (ie 32Mbyte, 64Mbyte, 128Mbyte and 512Mbyte)

Dynamic memory allocation is one of the key advantages and advancements in the 810E chipset.

Intel® Hub Architecture

In developing the 810E chipset and making the architecture capable of scaling with the requirement of future microprocessors and multimedia/internet applications, Intel's designers saw the PCI bus as a primary limiting factor. The Intel 810E chipset is the second in a series of Intel chipset products to be based on the Intel® Hub Architecture that removes the PCI bus as the main device interconnect. This new architecture provides each critical multimedia subsystem with a direct link to the chipset. For example, data can now move directly from an IDE storage device to memory through a 266Mbyte/s I/O channel without PCI bus contention or bandwidth limitation. The dedicated links to IDE, audio, modem, and USB subsystems ensure deterministic access to/from memory providing improved performance, optimal concurrency, and previously unattainable audio/video isochrony.

The following diagrams illustrate the general organization of congenital chipset partitioning and the new Intel Hub Architecture.

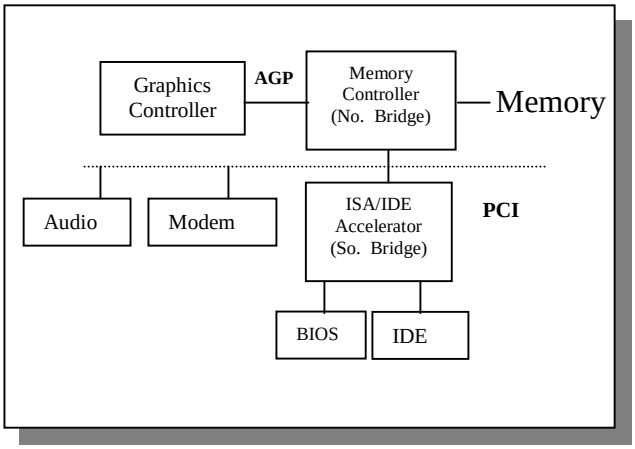


Figure 5. Earlier Generation Chipset Partitioning

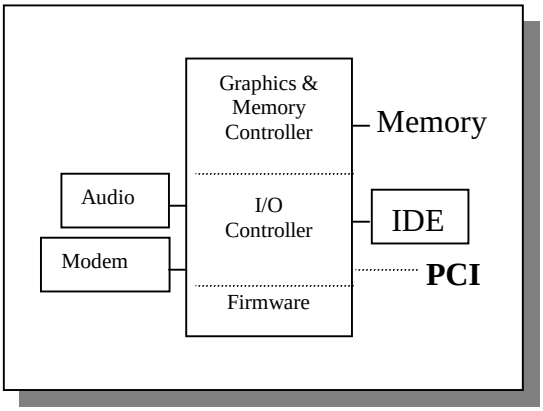


Figure 6. Intel® Hub Architecture

It is this new chipset architecture that now enables platforms to deliver on the promise of legacy ISA elimination. By creating direct interfaces for traditional ISA & X-bus functionality, the overhead of legacy 5V ISA support can be effectively removed.

The I/O control portion of the Intel 810E chipset is implemented as a separate device in order to isolate platform elements that are common across market segments (and future Intel Hub Architecture based segment-specific chipset products).

Digital video output capabilities

The Intel® Digital Video-Out Port in the graphics controller supports digital display devices (as well as TV-Out through an encoder). The digital out-port can be tied to a hardware transmitter chip used to communicate with the desired digital display device. In most situations the digital display device will be a digital flat panel although other devices such as digital CRT are starting to emerge on the market.

The Intel® 810E chipset is compliant with Intel® Digital Visual Interface (DVI), the standard created by the Digital Display Working Group (DDWG). This standard opens the door to new display technologies such as digital CRT and higher resolution LCD panels. With future OS support, users who hot plug in these display devices will have true plug and display.

New levels of differentiation

The Intel 810E chipset supports flexible board designs from Celeron with 66 MHz host bus to Pentium® III with 133MHz host bus. With "flex" 810E chipset, system manufacturers can reuse their R&D to span from mainstream market segments to the value PC segment - all with just one board. The Intel® 810E chipset is available today to take advantage of future Intel microprocessors available tomorrow.

The Intel® 810E chipset provides an interface for an optional 4Mbyte of 100/133MHz SDRAM display cache providing 3D performance that scales relative to the additional memory cost. The following table illustrates the range of processors and motherboards possible with the 810E chipset:

CPU	Processor Package	82810E GMCHe-A0 (Flexible MB only)
Intel® Celeron processor 66 MHz FSB 100 MHz FSB	PGA370 FC-PGA	Yes
Intel® Pentium® III processor 100 MHz FSB 133 MHz FSB	PGA370 FC-PGA SC242	Yes
Intel® Pentium® II processor 66MHz FSB	SC242	Yes

Table 2. Processor and motherboard combinations with 810E chipset

Board designers may choose to further reduce cost by producing small form factor boards with reduced I/O expansion or providing only ATA33 drive capability. The following table shows three configurations possible with the 810E chipset components.

System Integrator – lowest cost	Channel/DIY – lowest cost	Scalable graphics performance
• µATX form factor • No display cache • ATA33 drive support	• mini ATX form factor • no display cache • ATA33 or ATA66 support	• ATX form factor • 4Mbyte display cache • ATA33 or ATA66 support

Table 3. Typical Intel 810E chipset based motherboard configurations

It is relatively simple for chipset designers to assign new pins and gates to enable a new feature or protocol. The challenge presents itself in providing an architecture that provides the full capability of the new feature and assures maximum performance in a heavily loaded environment. Intel Hub Architecture meets these challenges and enables new features to move quickly into the all PC segments. The Intel 810E chipset delivers several advanced (and cost-effective) features not found in earlier generations of Intel® chipsets.

- Integrated AC'97 links for scalable soft audio and modem implementation.
- Dedicated IDE path with support for ATA66 – ensures available bandwidth during peak transfers.

- Flexible 66, 100 or 133MHz host processor interface to support existing and upcoming Intel Celeron and Pentium III processors.
- Support for uATX (4 PCI devices) or ATX (6 PCI devices) configurations – additional PCI req/grant pair.
- 3D graphics capability with integrated hardware motion compensation, DVD decoding, digital flat panel interface and TV out.
- ISA legacy elimination for PC'99 compliance.
- Asynchronous or synchronous memory interface for PC100 SDRAM performance gains regardless of processor host frequency
- New support of local display cache 4MB 133 or 100 MHz SDRAM
- Integrated hardware random number generator (RNG).
- Instantly Available PC for fast system restart and lower power consumption.

The Intel 810E chipset was designed to enable a high degree of scalability so motherboard and system vendors can create the best cost/performance equation for their target price point. Regardless of the configuration or SKU, the chipset's graphics capabilities, features and optimized architecture ensure excellent value.

3. Why use motherboards based on the Intel® 810E chipset for mainstream systems?

The PC market has undergone rapid expansion in recent years and is poised for greater growth. New PC price points and expanding access to the Internet are rapidly creating new sales opportunities. As a result of Intel's comprehensive approach to system cost reduction, the Intel 810E chipset offers a balanced platform with capabilities to meet a variety of needs.

- **Processor independent**. The new 810E chipset is unique in that it can be paired with the Intel® Celeron™ processor, Pentium® II processor and Pentium® III processor. With the 810E chipset, Intel delivers a platform that supports a variety of system configurations spanning from the mainstream to value segments as well as the new micro- and mini-ATX designs.

- **Product differentiation.** The 810E chipset also offers system builders the opportunity to differentiate their products from the competition through processor and clock ranges and memory speed selections, and still grow a profitable business with new technology that combines performance, flexibility and value.

  The 810E supports SDRAM memory speeds of 66 and 100 MHz which, when matched with either the Intel Celeron processor, Pentium II processor, or Pentium III processor, offers performance for a wide range of platforms.

- **Segment and user differentiation.** Computer users are differentiated as much by the applications they use as they are by their budgets. Over the years certain applications have evolved on various operating systems and obtained a position of leadership. To meet this challenge Intel has developed state-of-the-art software drivers that have been fully qualified and validated for all the leading and legacy APIs and operating systems. Drivers are available for:

  – Operating systems: Win95, Win98, O/S 2, NT4, Win2000 and Linux
  – APIs: DirectX 6 and 7, and OpenGL 1.1

- **Elimination of peripherals.** With the 810E chipset, the system delivers optimal performance and enhanced value through a variety of system efficiencies, including reduced need for costly peripherals. For example,

  – the integrated AC'97 (Audio Codec) delivers stereo quality sound and 56Kbps modem technology requires only the addition of an AMR riser card,

  – and integrated hardware motion compensation technology allows DVD playback without a separate decoder card.

- **Peripheral support.** Integration without full support of all leading and new peripherals would be self limiting of little value to the OEM. The 810E meets this need with:

  - Two USB ports
  - DVI flat-panel support
  - Six PCI slot support
  - Alert on LAN
  - 810E motherboards support 4 MByte display cache

- **Lower quality and validation costs.** With the 810E chipset there's no need to invest in extensive quality and validation processes, because Intel conducts extensive tests on hardware and software, using popular operating systems and peripherals.

- **Lower inventory costs.** The drivers and software to optimize the performance of motherboards based on the 810E chipset are located on one CD. Also, as mentioned earlier, system builders can reduce inventory costs, because the 810E chipset requires fewer discrete components such as sound cards, video cards and modems.

  Also, with the 810E chipset's support for legacy processors and current Value and Mainstream processors, as well as future processors, a motherboard almost never has to be made obsolete.

- **Lower support costs.** With cost sensitive systems, integrated chipsets will result in fewer returns and improve the system developer's bottom line

- **Easy upgrades.** Customers who wish to upgrade to a Pentium processor-based system will be pleased that the 810E chipset supports all processors.

The Intel 800 family of chipsets delivers long-term solutions, and motherboards based on the 810 chipsets and 810E chipsets are just the beginning. All of these features and an Intel® processor offer a superior solution for the most cost-sensitive customers. Using the 810E chipset as a building block, system builders can now deliver the platform your customers require at prices they can afford.

Summary

Motherboards based on the 810E chipset provide outstanding features and capabilities that optimize performance of the processor, at an exceptional value.

At the core of the 810E chipset is a memory controller with built-in graphics technology. By optimizing crucial memory arbitration, the 810E chipset is a more responsive and cost-effective system.

The *82810E Memory Controller Hub (GMCH)* features Intel® graphics technology and software drivers, using Direct AGP (integrated AGP) to create vivid 2D and 3D effects and images. The 82810E features integrated Hardware Motion Compensation to improve soft DVD video quality and a digital video out port that enables connection traditional TVs or the new space-saving digital flat-panel displays.

Intel Dynamic Video Memory Technology (D.V.M.T.) is an architecture that offers break-through performance with more efficient memory utilization and direct AGP. The system O/S uses the Intel software drivers and dynamic intelligent memory arbiter to support richer graphics applications.

The System Manageability Bus allows networking equipment to monitor the 810E chipset platform. Using ACPI specifications, the system manageability function enables low-power sleep mode and conserves energy when the system is idle.

The *82801 I/O Controller Hub (ICH)* employs the Controller Hub Architecture which makes a direct connection from the graphics and memory to integrated AC97 controller, the IDE controllers, dual USB ports and PCI add-in cards. At 266 MB per second, Intel Hub Architecture provides twice the bandwidth of the PCI bus.

The *Integrated Audio-Codec 97* controller enables software audio by using the processor to power integrated sound and modem software. Reusing existing system resources adds flexibility, improves sound quality and lowers system BOM costs by eliminating components.

Feature	Benefit
Validated with Pentium® III processor	Brings next generation processor technology to the mainstream PC
133/100/66 MHz FSB capability	Flexibility, one SKU solution for value and mainstream PCs
133/100 MHz display cache	Enhanced 3D and 2D performance
New graphics driver	Enhanced 3D with a 133 MHz display cache, provides Linux Operating System support
Intel® Hub Architecture	Optimized driver supports Intel 810 and 810E. Increase in I/O bus bandwidth allows better concurrency for rich multimedia applications
Integrated graphics/AC97 controller	BOM cost savings, more flexibility and better audio quality
Intel 3D graphics with Direct AGP	Vivid 2D and 3D graphics, BOM cost savings, efficient use of system memory for graphics, O/S and applications
Intel Random Number Generator (RNG)	Enables ISVs to strengthen security products with stronger encryption, digital signing and security protocols
Digital Video Output	Allows connection of traditional TV or new digital flat-panel displays; compatible with Intel® DVI specification
Soft DVD MPEG-2 playback with Hardware Motion Compensation	Lifelike video and audio Plug and Play
2 USB ports	Energy savings
Low power sleep modes	More stable platform, higher quality graphics, reduced OEM support costs
One software driver code base	Validated with Intel
82810E Memory Controller Hub	421 Ball Grid Array (BGA)
82801 Integrated Controller Hub	241 Ball Grid Array (BGA)

Table 4. Intel 810E Chipset Features and Benefits

For more information,
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